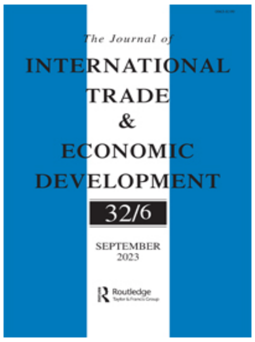

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Nida Jamil, Theresa Chaudhry and Azam Chaudhry

Faculty of Economics, Lahore School of Economics, Lahore, Pakistan

ABSTRACT

Increased market access through trade liberalization can affect the markups, prices, and marginal costs of exporters. Understanding these dynamics is critical for firms and policymakers, particularly as they formulate export strategies. We examine the impact of China lowering tariffs on Pakistani products under the Pakistan–China Free Trade Agreement (FTA), which gave Pakistani exporters greater market access. Using disaggregated output and price data for textile manufacturers in Punjab, Pakistan, we estimate product-level markups and marginal costs using the methodology of De Loecker, Goldberg, Khandelwal, and Pavcnik (2016) ["Prices, Markups, and Trade Reform." *Economterica 84* (2): 445–510]. We then extend this to the firm level by using the methodology of De Loecker and Warzynski (2012) ["Markups and Firm-Level Export Status." *American Economic Review*, 2437–2471]. We find that Pakistani firms exporting to China followed a dynamic pricing strategy by reducing prices to compete with global competitors in the Chinese market. We also find evidence of a decrease in marginal costs as a result of reductions in X-inefficiencies. But because Pakistan's exports to China are relatively homogeneous, the extent of quality differentiation and markup margins was limited. Finally, we find evidence of pro-competitive effects.

KEYWORDS Firm-Level Productivity; Trade Liberalization; Free Trade Agreement; Tariffs; Markups; X-inefficiency; Dynamic Pricing; Pro-competitive Effects

JEL CLASSIFICATIONS D22, D23, F14, F61, L11

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1. Introduction

Discussions of markups have always been crucial in the literature on firm dynamics. Policymakers are interested in understanding how changes in competition resulting from policy changes impact a firm's market power, commonly estimated through adjustments in markups. We study markup heterogeneity in the context of a free trade agreement and explore the consequences of this policy shock that resulted in reduced tariffs and increased export opportunities for firms in a developing country.

CONTACT Nida Jamil nidajamil@lahoreschool.edu.pk Faculty of Economics, Lahore School of Economics, Intersection Main Boulevard Phase VI DHA and Burki Road, Lahore 53200, Pakistan

We examine the changes in firm dynamics as a result of the Pakistan–China Free Trade Agreement (FTA) signed in 2006 under which both countries lowered tariffs to increase trade. Lower tariffs on both sides caused an influx of Chinese products to Pakistan while Pakistani firms also enjoyed greater access to Chinese markets. Gaining access to foreign markets due to trade agreements can impact a firm's ratio of price to marginal cost (i.e. markups) (Jafari et al. 2023). We examine the adjustments in markups by focusing on the case of Pakistani exporters which had greater access to China under the FTA by focusing on firms in Pakistan's textile sector, its largest exporting sector.

We specifically focus on China as an export market destination because of its strategic importance in the world, both economically and militarily. China has made significant efforts to extend its regional and global influence through the Belt and Road Initiative (BRI) which was formally launched in 2013. Through land and sea transportation networks that include energy pipelines, railways, highways, and ports, the Chinese investment portfolio is in excess of $1 trillion and aims to improve China's connectivity within Asia and beyond. The scope for the BRI is extremely ambitious: to date, 147 countries have signed on to projects or expressed an interest in doing so, representing two-thirds of the world's population and 40% of global GDP. According to President Xi Jinping, such a network would also increase the international use of the Chinese currency, the yuan, and 'break the bottleneck in Asian connectivity' (McBride, Berman, and Chatzky 2023).

According to analysts, the greatest investment China has made so far under the BRI is in Pakistan in the form of the China–Pakistan Economic Corridor (CPEC). Approximately $62 billion have been spent on a collection of projects connecting China to Pakistan's Gwadar Port on the Arabian Sea, making Pakistan especially important for the success of the BRI. In addition to investing in physical infrastructure, China has supported special economic zones to create jobs in partner countries and has also shared technologies with these countries, such as Huawei's 5G network. China has also promoted soft power initiatives, such as giving Pakistan and the ASEAN countries greater access to its markets. However, critics are concerned not just about the unsustainable debt that countries such as Sri Lanka and Pakistan have incurred, but also about the strategic role that these ports may play in China's military strategy in the region. The United States shares some Asian concerns that the BRI might be used for China-led regional economic and military expansion. As a result, President Biden has maintained his predecessors' skeptical tone towards Beijing's activities, but Washington has struggled to offer participating states a more enticing economic agenda (McBride, Berman, and Chatzky 2023). Under these circumstances, it is important to examine the implications of economic ties with China for states critical to the success of the BRI, such as Pakistan.

We begin our study by using firm-level data to estimate a production function in order to back out the output elasticities required for markup estimation by using a proxy variable approach introduced by Olley and Pakes (1996) and Levinsohn and Petrin (2003) with further modifications done by Ackerberg, Caves, and Frazer (2015). We then use a dynamic panel approach developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998).

Our first set of results are based on proxy variable methods developed by De Loecker et al. (2016) to estimate output elasticities and markups at the product level. Their methodology helps correct for unobserved input price bias and unobserved input allocation bias as well as omitted output price bias. Moreover, their estimation of the production function and markups has the advantage of not assuming any particular form of competition, consumer demand, or market structure.

We also estimate markups at the firm level using De Loecker and Warzynsksi's (2012) approach using two other methodologies for the output elasticity estimation: Blundell and Bond's (2000) System GMM methodology (hence System GMM) with and without external instruments (based on Roux et al. 2021) and the methodology of Gandhi, Navarro, and Rivers (2020) (hence GNR).

Based on these methods, we then estimate the impact of trade liberalization (reduction of tariffs by China in our case) on product and firm-level markups for Pakistani firms exporting to China. We also examine how prices and marginal costs respond to trade liberalization. We then attempt to find evidence regarding the welfare implications of trade liberalization by examining the presence of pro-competitive effects.

The existing literature in this context has explored how firms adjust prices and markups in response to trade policy changes or export market entry. India's trade liberalization led firms to face more competition from abroad but also gave them access to cheaper imported inputs. As a result, firms reduced prices by less than the fall in marginal costs, thereby increasing markups (De Loecker et al., 2016). Hornok and Muraközy (2019) find that imports have a strong positive correlation with markups both within and across firms in Hungary because of quality improvements that occurred after firms gained access to high quality inputs from developed countries. However, they find no correlation between the export activities of a firm and its markups as a result of firms facing higher competition in the export market as compared to the domestic market. Fan et al. (2018) find similar evidence of a greater increase in markups for Chinese firms with higher import dependence.

On the other hand, Garcia-Marin and Voigtländer (2019) find that prices and marginal costs of firms in Chile, Colombia, and Mexico fell almost in tandem when tariff reductions by export partners increased market access, which resulted in small or insignificant increases in markups. In contrast, liberalization of tariffs induced by WTO accession led Ghanaian firms to reduce markups (Damoah 2021). Gonzalez-Garcia and Yang (2022) use firm level data from 83 emerging and developing economies from 2000 to 2017 and find that increased market access and international trade leads to lower markups. They find that over a five-year period, the cumulative impact of each cycle of trade liberalisation leads to a 4% drop in markups.

A growing branch of the literature measures the relationship between trade status and markups. Bellone et al. (2016) argue that opening up to trade has two counterbalancing effects on domestic exporters. On one hand, prices fall as a result of freight cost absorption, which is stronger the more distant the export market. On the other hand, prices increase as a result of higher quality exports, which is stronger when firms access larger export markets. They find evidence for French exporters that the scope for quality differentiation is higher in export markets as compared to local markets, hence markups are higher for exporters as compared to non-exporters. Dzung (2022) finds that Vietnamese manufacturers increase the rate of quality upgrading in response to tariff reductions and increased import competition. De Loecker and Warzynski (2012) find similar results of increased markups for exporters when Slovenian firms gained market access after the fall of the Eastern Bloc.

Moreover, the literature on the estimation of markups has itself evolved over time. The first generation models were based on strong assumptions regarding the nature of competition. The Dixit–Stiglitz model assumed monopolistic competition without allowing for markup heterogeneity; the price models under Bertrand competition also had limited scope for markup heterogeneity. More recent literature has attempted to allow for markup heterogeneity in various settings. Bernard et al. (2003) allows for heterogeneity amongst plants by introducing Bertrand competition in a Ricardian setting, while the work of Melitz (2003) is based on a monoplistic setting with an extension of Krugman's (1980) model to allow for firm level productivity differences. Later work by Melitz and Ottaviano (2008) allow productivity and markups to vary according to market size and the extent of trade integration. Their model allows for more productive firms to have higher markups along with higher profits. Using a monopolistically competitive model, they generate markups based on the difference between a firm's marginal cost and the cutoff marginal cost. Bellone et al. (2016) builds on the Melitz and Ottaviano (2008) model by allowing quality differences across firms and by allowing a firm's location to impact its performance. Blas and Russ (2015) build on the Bernard et al. (2003) model by incorporating price rigidity and a finite number of rival firms which allows trade costs and differences in technology to influence the markup distribution.

With the evolution of the literature on markups, accounting for markup heterogeneity has recently led researchers to examine the pro-competitive effects of trade. These effects may reduce markups, which can have welfare enhancing effects. The idea behind this is that trade changes the level of competition, increasing the gains from trade and increasing the costs of protection (Helpman and Krugman 1989). Arkolakis et al. (2019) use gravity models to generate variable markups, which then determine the existence of pro-competitive effects. According to their model, a decline in trade costs lowers the demand for domestic goods, which lowers markups after trade liberalization. This reduces distortions, ultimately increasing welfare. Crowley, Han, and Prayer (2022) also suggest that tariff reductions under trade agreements have important pro-competitive effects since they boost entry and reduce exporters' (tariff exclusive) price-cost markups. Gonzalez-Garcia and Yang (2022) also study the underlying mechanisms and confirm a pro-competitive effect: increasing import penetration and import quantities result in large decreases in markups. Therefore, increasing international competition and increased imports force domestic firms to behave more competitively, reducing profit margins.

Our research contributes to the existing body of literature in multiple ways. First, while this study is not the first to show a link between trade liberalization and market power, it differs from earlier research that focused on trade links between advanced economies or with a focus on a single developing economy. In this study, we examine the impact of trade liberalization between two middle-income economies, Pakistan and China. Additionally, the context is particularly important given the strategic role Pakistan plays in China's BRI.

Second, we contribute to the literature by precisely measuring product level and firm-level markups by taking advantage of a detailed disaggregated micro-data set. Our rich dataset has disaggregated output and price information not just at the firm level but also at the product level. Hence, we have product-, firm-, and time-level variation in our data set. This enables us to measure markup and marginal cost both at the product level (based on De Loecker et al. (2016) and at the firm level (based on De Loecker and Warzynksi's (2012). This disaggregated data also helps us directly correct omitted price bias rather than relying on sectoral deflators. In addition, it allows us to control for unobserved input price bias and unobserved input allocation bias for multi-product firms as in De Loecker et al. (2016). Also, this data set also allows us to take quality concerns into account, as raised by Atkin, Khandelwal, and Osman (2019), in our measure of markups.

Third, our research adds to the continuing debate about the relationship between trade policy and welfare outcomes (see Arkolakis et al. 2019) in which pro-competitiveness plays a crucial role in linking tariffs and markups at both the product and firm level. The literature examining pro-competitive effects for developing countries is relatively scarce.

Finally, while much of the literature on trade-firm linkages has examined the effects of relaxing import restrictions, few researchers have considered the effects of firms gaining access to foreign markets under trade liberalization. Even the existing evidence of pro-competitive effects by Gonzalez-Garcia and Yang (2022) is based on the welfare implications of rising import penetration and import volumes. As an alternative mechanism, we examine the welfare implications of output tariff reductions and greater access to global markets.

Our results point out towards dynamic pricing as suggested by Garcia-Marin and Voigtländer (2019) where firms exporting to China reduce their prices in order to compete with other firms in the Chinese market. Marginal costs did fall as a result of the FTA, indicating the presence of productivity improvements for exporters, but markups, at least at the firm level, remain unresponsive to trade liberalization. Much of this is because Pakistan has mainly exported products from the spinning sector to China. Products within this segment are relatively homogeneous and have limited scope for quality differentiation as compared to products within other segments like clothing, finishing or interior. Thus, Pakistan has been exporting products to China which have lower markup margins and less room for differentiation.

2. Pakistan China Free Trade Agreement (FTA)

Pakistan and China are neighboring countries that have historically enjoyed friendly political and economic relations. In 2006, the countries negotiated tariff reductions to enhance trade and strengthen this relationship. The FTA between both countries was designed in two phases. The first phase ended in 2012 and the second phase began in 2013. Diplomatic relations between both countries have further deepened after the China–Pakistan Economic Corridor (CPEC) project under China's One Belt One Road initiative.

Though it appeared to be an opportunity for both countries, increases in trade flows have worked in the favor of China. Figure 1 shows that despite an increase in the Pakistani exports to China, the imports from China have increased at a faster pace, making China the main beneficiary of the FTA. China has availed 57% of the concessions available under the FTA while Pakistan has only been able to utilize 5% of the concessions (Mukhtar 2019).

One of the potential reasons for this is that even though China has lowered its tariffs on Pakistani goods after the FTA, the tariff rates imposed by China on products from the ASEAN countries are much lower (see Figure 2).

In Table 1A–E, we further look at the FTA by specifically focusing on the largest exporting sector of Pakistan, i.e. the textile sector. Dividing the textile sector into five segments, namely, spinning, clothing, interior, finishing and technical, we see that even

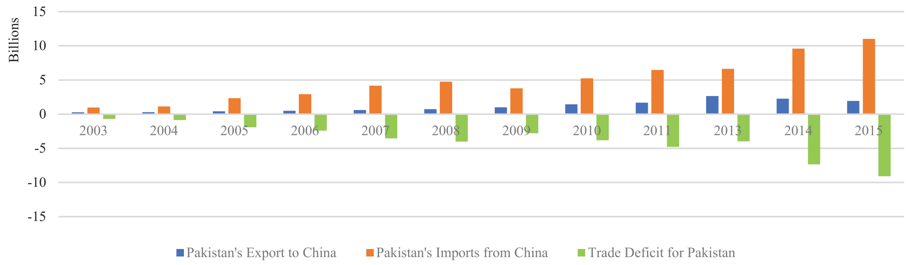


Figure 1. Trade Flows between Pakistan and China (US $ Billions). Source: UN Comtrade Data.

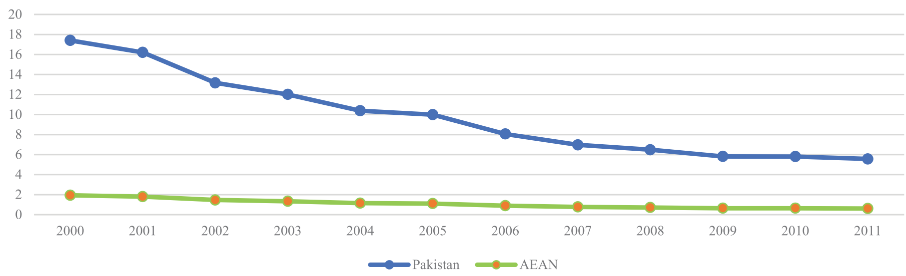


Figure 2. China's Average Tariff Rates (%) for Pakistan and ASEAN countries. Source: World Integrated Trade Solution (WITS).

after a decade of the FTA (as of 2017) Pakistan only ranks among the top five countries exporting to China in the spinning sector.[1]

According to Afraz and Mukhtar (2020) under the FTA, 'Priority 1' products for Pakistan are the ones which have the highest export potential to China, with 401 product codes falling in this category. After the second phase of the FTA, Pakistan exported $1.6 billion worth of these products to China whose imports totaled $148.8 billion. Priority 2 products are the ones in which Pakistan has already established itself in the world market and China is an established world importer of these products. Within this category there are 391 product codes to which Pakistan has less access than other countries exporting to the Chinese market. This includes important textile product categories, like 15 product codes within the cotton yarn category and 56 product codes within the non-cotton and man-made fiber and men and women's knitted garments category. Priority 3 products are the ones which China imports, but Pakistan does not export and could be Pakistan's potential new exports. Within this category, 12 percent of the product lines for Pakistan still have higher tariffs imposed by China as compared to its high-value trade partners.

3. Empirical methodology

In this section we discuss the estimation techniques used in this study. We estimate product level markups and marginal costs using the methodology developed by De Loecker et al. (2016). Firm-level markups and marginal costs are estimated using the methodology developed by De Loecker and Warzynski (2012). We discuss both methodologies below.

Table 1A- -E. China's Principal Suppliers Segment Wise for the year 2017.

Table 1A. Spinning segment.

Countries	Rank	No of Lines	Share	Value (thousands of US $)
Total		**62**	**100.00**	**5,168,998**
Vietnam	1	34	36.62	1,892,769
India	2	34	20.66	1,067,759
Pakistan	3	16	15.87	820,271
Indonesia	4	22	7.89	407,877
Uzbekistan	5	8	4.36	225,355
Chinese Taipei	6	47	3.63	187,573
Bangladesh	7	4	2.10	108,545
United States of America	8	35	2.09	107,873
Malaysia	9	13	1.89	97,579
Korea	10	49	1.56	80,679

Table 1B. Clothing segment.

Countries	Rank	No of Lines	Share	Value (thousands of US $)
Total		**143**	**100.00**	**4,238,872**
European Union	1	143	21.87	927,020
Vietnam	2	103	17.29	732,724
Bangladesh	3	76	7.64	323,972
Korea	4	68	6.86	290,978
Chinese Taipei	5	95	6.82	289,128
Korea	6	128	6.29	266,579
Japan	7	129	5.20	220,591
Indonesia	8	82	4.47	189,617
Turkey	9	103	4.36	184,991
Cambodia	10	76	4.36	184,858
Pakistan	13	51	1.14	48,524

Table 1C. Interior segment.

Countries	Rank	No of Lines	Share	Value (thousands of US $)
Total		**135**	**100.00**	**441,922**
European Union	1	128	16.52	73,010
Korea	2	81	12.71	56,154
India	3	100	10.83	47,654
Japan	4	95	10.55	46,638
Chinese Taipei	5	72	9.78	43,211
United States of America	6	95	7.16	31,663
Turkey	7	71	6.79	30,021
Pakistan	8	39	6.17	27,286
Thailand	9	57	4.43	19,556
Bangladesh	10	25	2.86	12,623

Table 1D. Finishing segment.

Countries	Rank	No of Lines	Share	Value (thousands of US $)
Total		**126**	**100.00**	**2,200,595**
Japan	1	119	29.99	659,858
European Union	2	112	14.58	320,894
Korea	3	112	13.86	304,959
Chinese Taipei	4	94	11.91	262,005
United States of America	5	109	8.57	188,689
Thailand	6	65	5.03	110,640
Vietnam	7	59	3.06	67,438
Malaysia	8	47	2.25	49,536
Pakistan	9	32	1.70	37,375
Indonesia	10	52	1.68	37,035

(continued).

Table 1. Continued.

Table 1E. Technical segment.

Countries	Rank	No of Lines	Share	Value (thousands of US $)
Total		**32**	**100.00**	**422,353**
European Union	1	32	23.93	101,080
Japan	2	31	19.36	81,761
Chinese Taipei	3	31	13.08	55,230
Korea	4	29	12.79	54,036
United States of America	5	30	7.27	30,699
India	6	18	4.46	18,830
Hong Kong, China	7	17	3.65	15,407
Vietnam	8	20	3.21	13,545
Thailand	9	18	2.97	12,537
Indonesia	10	17	2.15	9,079
Pakistan	37	4	0.00	13

Source: World Trade Organization (WTO) Tariff analysis.

3.1. Product level markup and marginal cost estimation based on DeLoecker et al. (2016)

The De Loecker et al.(2016) methodology works well in the case of multi-product firms, especially when disaggregated price and physical quantity data is available, as in our case. The main contribution of this methodology is that it estimates a product-level production function (as compared to a firm-level production function, which is the standard case in the literature). Hence, the marginal cost and markups are estimated at the product level in our study. In addition to this, the De Loecker et al.(2016) methodology has the added benefit of avoiding strong assumptions related to consumer demand, market structure, or the nature of competition. Moreover, this methodology addresses the issues of *omitted input price bias* and *unobserved allocation of inputs* for firms producing multiple products.

Using materials as the proxy variable (flexible input) in the control function, De Loecker et al. (2016) estimate a quantity-based gross production function by using disaggregated physical output and price data at the product level. Using disaggregated data helps control the omitted output price bias. To control the omitted input price bias, De Loecker et al. (2016) use the idea that high quality inputs (which are complements in the production process with other inputs) make high quality output and, by this definition, output prices contain information regarding input prices. Assuming that input prices increase monotonically in input quality, which impacts output quality, the authors express input prices as a function of output prices, market share and firm product dummies as a proxy for input prices. They estimate the production function using only single product firms to avoid the biases that arise due to input allocation across multiproduct firms. However, since the choice to become a multi-product firm is not random and is based on firms' productivity, De Loecker et al. (2016) apply a sample correction procedure where firms self-select into being multi-product based on a productivity threshold and its previous information set.

Finally, the production function is estimated by GMM based on the moment conditions related to the innovation in the productivity shocks, in line with Ackerberg, Caves, and Frazer (2015) (commonly referred to as the ACF approach) using materials as static input and capital and labor as dynamic inputs. Below we briefly describe how De Loecker et al. (2016) uses their methodology to estimate markups and the marginal cost at the product level.

The production function for the firm f can be expressed in equation (1) where it produces product j at the time t:

$$Q_{fjt} = F_{jt}\,(V_{fjt}, K_{fjt})\Omega_{ft} \tag{1}$$

where Q is the physical output, V is a vector of variable inputs which are adjusted freely, and K is a vector of fixed inputs which have some adjustment cost.Ω_{ft} is the firm's specific productivity. J_{ft} is the number of products produced by firm f at time t. Defining W^{v}_{fjt} as the vector of variable input prices and W^{K}_{fjt} as a vector of dynamic input prices and assuming that the production function F_{jt} is continuous and twice differentiable with respect to at least once variable input V_{fjt}, the firms minimize their costs by taking output quantity and input prices W_{fjt} as given at the time t. The Lagrangian for the cost minimization problem for firm f producing product j at time t can be written as:

$$L(V_{fjt}, K_{fjt}, \lambda_{fjt}) = \sum_{(v=1)}^{V} W^{v}_{fjt}V^{v}_{fjt} + \sum_{(k=1)}^{K} W^{K}_{fjt}V^{K}_{fjt} + \lambda_{fjt}[Q_{fjt} - Q_{fjt}(V_{fjt}, K_{fjt}, \Omega_{ft})] \tag{2}$$

Taking the derivative with respect to any variable input V^{V} used in the production of product j and letting λ_{fjt} be the marginal cost we get:

$$\frac{\partial L_{fjt}}{\partial V^{V}_{fjt}} = W^{v}_{fjt} - \lambda_{fjt}\frac{\partial Q_{fjt}(.)}{\partial V^{V}_{fjt}} \tag{3}$$

Rearranging and multiplying both sides of the equation with $\frac{V_{fjt}}{Q_{fjt}}$:

$$\frac{\partial Q_{fjt}(.)}{\partial V^{V}_{fjt}}\frac{V_{fjt}}{Q_{fjt}} - \frac{1}{\lambda_{fjt}}\frac{W^{v}_{fjt}V_{fjt}}{Q_{fjt}} \tag{4}$$

The left-hand side expression of equation (4) represents the output elasticity with respect to the variable input V^{V}. Denoting the output elasticity as $\theta = \frac{\partial Q_{fjt}(.)}{\partial V^{V}_{fjt}}\frac{V_{fjt}}{Q_{fjt}}$ and defining the markup as $\mu_{fjt} = \frac{P_{fjt}}{\lambda_{fjt}}$, expression (4) can be written as:

$$\mu_{fjt} = \theta^{V}_{fjt}\left(\frac{P_{fjt}\,Q_{fjt}}{W^{V}_{fjt}V^{V}_{fjt}}\right) = \theta^{V}_{fjt}(\alpha^{v}_{fjt})^{-1} \tag{5}$$

where α^{v}_{fjt} is the share of variable input V^{V}allocated in the production of product j in the total sales of product j. Both the components of expression (5) are unobservable in the case of a multi-product firm, since all the variables are indexed by product j. In contrast to this, in the case of a firm-level analysis, the output elasticity with respect to the variable input is directly estimated using a production function, typically based on using deflated revenues, while the firm-specific input share is directly observed in the data. This approach of estimating the production function at the product level relies on estimating the output elasticity separately for each product manufactured and on estimating the product-level share of every input, usually unobserved.[2]

Therefore, De Loecker et al. (2016) develops a unique methodology to estimate the product-level production function as in (5). Once the product-level markupμ_{fjt} is estimated, the product-level marginal cost is then derived as:

$$mc_{fjt} = \frac{P_{fjt}}{\mu_{fjt}} \tag{6}$$

In order to estimate the production function at the product level to compute output elasticities, the production function defined in (1) is expressed in logs:

$$q_{fjt} = f_j\,(\chi_{fjt}; \beta) + \omega_{ft} + \varepsilon_{fjt} \tag{7}$$

where q_{fjt} is the log of output, which is a function of χ_{fjt}that represents a vector of the log of physical inputs $\{V_{fjt}, K_{fjt}\}$where β represents the respective coefficients. ω_{ft} is the log of productivity.

Let $\widetilde{\chi_{ft}}$ be the observed vector of price index-deflated input expenditures. Product-level input quantities χ_{fjt} for each input are then given as:

$$\chi_{fjt} = \rho_{fjt} + \widetilde{\chi_{ft}} - w^x_{fjt} \tag{8}$$

where ρ_{fjt} is the share of firm input expenditures allocated to product j at time t (in logs) and w^x_{fjt} is the deviation of the unobserved firm-specific input prices from the industry-wide input price index (in logs). Substituting this expression of physical inputs into equation (7) and denoting w_{fjt}as a vector of log firm-product specific input prices, De Loecker et al. (2016) obtain:

$$q_{fjt} = f_j(\widetilde{\chi_{ft}}; \beta) + A(\rho_{fjt}, \widetilde{\chi_{ft}}, \beta) + B(w_{fjt}, \rho_{fjt}, \widetilde{\chi_{ft}}, \beta) + \omega_{ft} + \varepsilon_{fjt} \tag{9}$$

Equation (9) in comparison to (7) has two additional unobserved terms: *A(.)* represents the *input allocation bias* which is present due to the unobserved product-level input allocation ρ_{fjt} and *B(.)* represents the *input price bias* which arises due to the unobserved firm-specific input prices w_{fjt}.

In order to estimate the production function, De Loecker et al. (2016) relies on single product firms, which makes the term $A(.) = 0$ since $\rho_{fjt} = 1$ in that case. Equation (9) can now be written as:

$$q_{fjt} = f_j\,(\widetilde{\chi_{ft}}; \beta) + B(w_{fjt}, \rho_{fjt}, \widetilde{\chi_{ft}}, \beta) + \omega_{ft} + \varepsilon_{fjt} \tag{10}$$

The main idea behind the De Loecker et al. (2016) approach is that the physical relationship between inputs and output is the same for both single and multi-product firms manufacturing the same product, and that the technology used to produce product *j* is independent of the technology used to produce other products by the firm. This input-output relationship for single product firms then helps to estimate the input allocation for multi-product firms.[3]

Using single product firms may, however, raise the issue of selection bias, since firms self-select into being a multi-product firm. For this reason, a selection correction procedure is implemented to correct for this based on a productivity threshold and the firm's information set.

Their methodology next considers addressing the omitted input price bias in *B(.)* in equation (10). Assuming higher input quality (more expensive inputs) are required to produce higher output quality, the input prices $w^x_{fjt}$are written as a function of output quality $v_{ft}$and firm location G_f:

$$w^x_{fjt} = w_t(v_{ft}, G_f) \tag{11}$$

where output quality$v_{ft}$is estimated based on the output price of the firm p_{ft}, vector of market sharesms_{ft}, vector of product dummies $D_{f,}$, and export status of the firm EXP_{ft}.Hence, equation (11) can be written as:

$$w^x_{fjt} = w_t(p_{ft}, ms_{ft}, D_{f,}EXP_{ft}, G_f) \tag{12}$$

Finally, the production function is estimated using the GMM procedure. Once the estimates of the production function are obtained, they are then used to back out the input allocation across multi-product firms by simultaneously solving a system of $J_{ft} + 1$ equations for each multi-product firm where J_{ft} is the number of products produced by firm f in time t. This then helps to calculate firm-level productivity and product-level markups and marginal cost as mentioned above.

3.2. Firm-level markup and marginal cost estimation based on De Loecker and Warzynksi (2012)

De Loecker and Warzynski (2012) introduce an empirical method for the estimation of firm-level markups (as opposed to product-level markups as in De Loecker et al. (2016) based on the standard cost minimization problem by relying on a variable input that has no adjustment cost. This framework estimates markups based on the output elasticity of the variable input and the share of the variable input's expenditure in total sales.

Assume firm I at time t has production technology as:

$$Q_{it} = Q_{it}(X^1_{it}, \ldots.., X^V_{it}, K_{it}, \omega_{it}) \tag{13}$$

where V is a set of variable inputs like labor, materials, and other intermediate inputs. Moreover, the firm relies on the capital stock K_{it}, which is dynamic in the production process. The only two assumptions to estimate markups are that $Q_{it}(.)$is continuous and is twice differentiable with respect to its elements.[4]

Assuming producers minimize costs, the Lagrangian function associated with the problem can be written as:

$$\mathcal{L}(X^1_{it}, \ldots.., X^{\mathrm{V}}_{it}, K_{it}, \lambda_{it}) = \sum_{v=1}^{V} P^{X^v}_{it} X^v_{it} + r_{it}K_{it} + \lambda_{it}(Q_{it} - Q_{it}(.)) \tag{14}$$

where $P^{X^v}_{it}$ are the prices for the variable input v and r_{it} is the price of capital. The first-order condition with respect to the variable input (without adjustment cost) gives us:

$$\frac{\partial \mathcal{L}_{it}}{\partial X^v_{it}} = P^{X^v}_{it} - \lambda_{it}\frac{\partial Q_{it}(.)}{\partial X^v_{it}} = 0 \tag{15}$$

where λ_{it} is the marginal cost of production.[5] Rearranging and multiplying both sides of the expression by $\frac{X_{it}}{Q_{it}}$ we obtain:

$$\frac{\partial Q_{it}(.)}{\partial X^v_{it}} \frac{X^v_{it}}{Q_{it}} = \frac{1}{\lambda_{it}} \frac{P^{X^v}_{it} X^v_{it}}{Q_{it}} \tag{16}$$

The above expression implies that the output elasticity of the variable input X_{it}^{v} should equal to its cost share $\frac{1}{\lambda_{it}} \frac{P_{it}^{X^v} X_{it}^{v}}{Q_{it}}$. This can be referred to as the *conditional cost function*, as under this cost minimization problem we can simply condition the use of dynamic inputs like capital (or any other inputs which have adjustment costs) without having to solve the full firm dynamic problem. This helps in avoiding having to make more assumptions than needed to estimate markups. Note that this holds for any cost minimizing firm irrespective of the competition and underlying demand structure.

As the last step to recover markups μ_{it} let it be defined as $\mu_{it} \equiv \frac{P_{it}}{\lambda_{it}}$. Using this definition of markup,[6] the above equation can be written as:

$$\theta_{it}^{X} = \mu_{it} \frac{P_{it}^{X} X_{it}}{P_{it} Q_{it}} \tag{17}$$

where θ_{it}^{X} is the output elasticity of input X_{it}. Rearranging we get:

$$\mu_{it} = \theta_{it}^{X} (\alpha_{it}^{X})^{-1} \tag{18}$$

where α_{it}^{X} is the share of the expenditure of input X_{it} in the total sales $P_{it}Q_{it}$. To estimate the markups, one only requires estimating the output elasticity of one (or more) of the variable input(s), which can be done by estimating the production function at the firm level. The latter term of the expression is directly observed in most micro-data sets. For our analysis, we estimate the firm-level output elasticity by using a system GMM estimator (Blundell and Bond 2000) and the methodology of Gandhi, Navarro, and Rivers (2020), which we refer to as GNR.

The extended or System GMM estimator (Blundell and Bond 1998) is one of the methods that estimate the firm-level output elasticities with respect to the variable input used to calculate markups and marginal cost strictly at the firm level (as opposed to the product level). The system GMM is based on a time-differenced equation (using level of inputs as instruments) and an equation in levels (using time-differenced inputs as instruments).

In order to estimate the output elasticities using the system GMM, we add in external instruments for labor and materials in addition to the time-differenced internal instruments as used in the standard system GMM. Following Roux et al. (2021) we instrument labor using a measure of 'bite' based on the ratio of the minimum wage as set by the government to the average wage paid by the firm. Once we have the measure of bite, we interact it with the change in minimum wage. This predicted change in the wage is then used as an instrument for labor. For materials, we use the exogenous variation in input prices as an instrument. A firm's demand for input x_{ft} will not only be based on its quality but also on the input price v_{ft}. Our argument is that a change in the prices of *other* goods that use the same input x will result in a shift in the input demand and hence, serve as an exogenous source of variation for input price v_{ft}. For this, we create a weighted average of the output prices that use a particular input to serve as a proxy for the demand for each material input. The material instrument for each firm is then constructed using the firm's input expenditure as weights.

We also estimate the output elasticities to estimate firm level markups based on the GNR (2020) methodology. The GNR (2020) methodology is based on the gross output production function. Collinearity may arise when output elasticity is estimated using materials as a fully flexible input. To correct this, the authors introduced additional restrictions based on the firm's first order conditions. The first order conditions are transformed into 'share equations' which non-parametrically identify output elasticity with respect to materials.[7]

Comparing the assumptions of the three methodologies used in this paper: De Loecker et al. (2016), system GMM (Blundell and Bond 1998) and GNR (2020), first we note that the De Loecker et al. (2016) is based on the Olley and Pakes (1996) proxy variable technique where the timing of the firm's input usage is based on firm's knowledge of its idiosyncratic productivity which itself follows a Markov process. This technique assumes a monotonic relationship between firm productivity and the flexible input (materials in this case) to form the control function. The system GMM also relies on the timing of the input choices, but unlike proxy variable techniques, it allows for firm fixed effects. In order to do this, however, it imposes more structure on the dynamics of firm-level productivity based on an AR(1) process. The second equation based on levels using lagged differences as instruments allows stationarity to be imposed. Ackerberg (2016), comparing these assumptions of these models, suggests that the tightening of the timing assumption by just one more period in a proxy variable method case like the De Loecker et al. (2016) is almost equivalent to the gain from adding in the stationarity assumption under the GMM. Gandhi, Navarro, and Rivers (2020) on the other hand assumes perfect competition both in the input and the output market while the system GMM and De Loecker et al. (2016) do not assume any explicit nature of competition in any market.

4. Data sources

In this section we briefly describe the data sources used in this analysis.

4.1. Census of Manufacturing Industries (CMI) Punjab, Pakistan

The Census of Manufacturing Industries (CMI) is a firm level census conducted every five years by the Punjab Bureau of Statistics in Pakistan. It is a detailed survey containing information regarding firm revenues along with input usage, including different capital stock measures, labor costs, and energy utilization. We use three waves of the CMI conducted for the years 2000, 2005, and 2010 to construct an unbalanced panel data set for the firms in Punjab, Pakistan.

In our study, we focus on the textile sector, which is the largest exporting sector of Pakistan. The main advantage of our data set is that, unlike most of the micro data sets, it contains disaggregated prices and quantity details for each firm f at product level j for time period t. Hence, we have three dimensions of variation in our data set; at the time, firm, and product level.[8] Using the actual output of the firm rather than relying on sectoral deflators helps us in attenuating the omitted output price bias in our estimation.

Table 2 shows us the size of the firms (as measured by their inputs) for exporters and non-exporters both pre-FTA (year 2000 and 2005) and post-FTA (year 2010). We can clearly see that exporters, to begin with, are much bigger in terms of inputs than non-exporters. Even after the FTA, exporters remain much bigger as compared to non-exporters.[9]

Table 2. Firm level summary stats for Textile Manufacturers according to the CMI.

	Exporters			Non-Exporters		
	Pre FTA		*Post FTA*	*Pre FTA*		*Post FTA*
CMI Year	*2000*	*2005*	*2010*	*2000*	*2005*	*2010*
Capital (PKR)	362,840	506,279	654,148	217,971	276,705	325,222
Labor	445	456	475	161	252	266
Materials (PKR)	364,714	413,323	1,410,323	155,008	180,341	193,270
Number of Firms	90	108	147	433	366	378

Source: Based on authors' own calculation using the CMI wave of 2000–2001, 2005–2006 and 2010–2011.

Table 3. Exporter matching between the CMI and textile export transaction data base.

	Pre FTA		*Post FTA*
CMI Year	*2000*	*2005*	*2010*
Number of Exporting Firms in the CMI	90	108	147
Percentage of Exporters matched with the CMI reporting China as their export destination	26%	21%	14%

Source: Authors' calculations based on the matching of the CMI and the Export Transactions Database.

4.2. Textile export transactions database

We use textile export transaction data set to identify firms that export specifically to China. This data set contains detailed information regarding the export shipments of each textile firm in Pakistan from the year 2000–2011. It contains details of every export transaction with information regarding the export destination, shipment date, shipment product code along with the shipment value.

We match firms in this data set with firms in the CMI to identify the firms in our analysis that export to China. Table 3 below shows the number of exporters reporting China as one of its export destinations.

4.3. World Trade Organization (WTO) tariff data

We use the World Trade Organization (WTO) Tariff Analysis Online Database to get the tariff rates applicable to each product in our analysis. The products are identified under the Harmonized System (HS codes) both in the CMI and the WTO tariff data. We focus on the tariffs imposed by China on textile products imported from Pakistan. We use the product-level tariffs as available for our product-level analysis. For the firm-level analysis, we aggregate the product-level tariffs using product revenue shares as weights to measure tariffs at the firm level.

5. Results and discussion

We examine the impact of the Pakistan–China FTA on the prices, marginal costs, and markups of the textile firms in Punjab, Pakistan. The purpose of this is to see the extent to which firms adjusted their mark-ups and took advantage of the tariff reductions by moving along the demand curve to capture a larger share of the market.

In order to test this, we analyze how marginal costs and markups have evolved with the FTA according to the export status of each firm. We begin by presenting the product-level estimates of markups and marginal costs based on the methodology by De Loecker et al. (2016). We then present the results at the firm level based on the output elasticities obtained using the system GMM and the GNR approach in the De Loecker and Warzynsksi (2012) framework.

5.1. Product level impact of the FTA on markups, prices and marginal costs

We study the impact of the FTA on markups, prices, and marginal costs using equation (19):

$$Y_{jft} = \alpha_t + \alpha_s + \alpha_{st} + \gamma\tau_{jt} + \theta\boldsymbol{C}_{ft} + \varepsilon_{jft} \tag{19}$$

whereY_{ft} is the markup, price, and marginal cost respectively of product j produced by firm f at time t. α_t represent the year fixed effects, $\alpha_s$represent the segment fixed effects within the textile sector, and α_{st} are segment-year fixed effects.[10] τ_{jt} are the product-level tariff rates imposed by China on product j at time t for the textile firms in Pakistan. $\boldsymbol{C}$ is a vector of controls including pre-FTA inputs, productivity, quality, and number of products produced by firm f at time t. It also controls for the missing year dummies. ε_{jft} is the idiosyncratic error term. In addition to this, we also control for the product-firm fixed effects.

In order to understand how the impact of the FTA varies according to the export status of the firms, we divide the firms into three categories (i) *Exporters to China*: firms which export to the China (ii) *Exporters to Other Destinations*: firms which export to countries other than China (iii) *Non-Exporters*: firms which do not export.

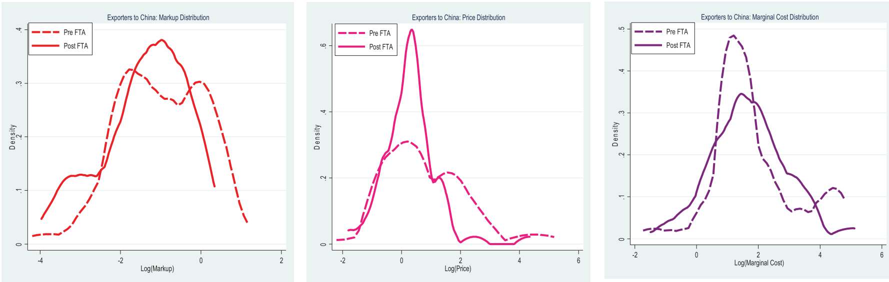
We extend equation (19) to allow for the export status of the firm according to our three categories along with the interaction of the export status with tariffs imposed by China to measure the impact of the FTA. The coefficient of this interaction term δ is our main variable of interest.

$$Y_{jft} = \alpha_t + \alpha_s + \alpha_{st} + B((Export\ Status,\ Export\ Status{*}\tau_{jt}) :\ \beta, \delta) + \theta\boldsymbol{C}_{ft} + \varepsilon_{jft} \tag{20}$$

Figure 3 shows the product level distribution of markups, prices and marginal costs both before (2000–2005) and after (2010) the Pakistan–China FTA went into effect for firms directly affected by the FTA, i.e. the firms exporting to China. The distribution shows an apparent reduction in their markups and prices, although the marginal cost distribution seems more diffuse after the free-trade agreement.

In Table 4, we see the impact of the tariff changes on product-level prices, marginal costs, and markups. In Panel A we test the impact of tariff reductions on the markups, price, and marginal costs for all firms and in Panel B we separate firms by their export status. In panel A, we can see that the tariff reductions under the FTA reduced the average product-level markups and prices, while marginal costs increased slightly. When we explore the impact of the FTA according to the export status of the firm, we find that marginal costs and markups of firms exporting to China fell around 5 percent and prices fell around 10 percent.[11] Exporters to other destinations raised their prices in response to higher marginal costs, while non-exporters lowered prices and markups marginally.

Lamorgese, Linarello, and Warzynski (2015) got similar results in their study of the impact of Chilean firms entering into three major FTAs with the US, the EU, and the Republic of Korea. They found that the products directly exposed to tariff cuts experienced a fall in prices and average unit costs. However, markups in their case



Markup Price Marginal Cost

Figure 3. Distributions of Product Level Markups, Prices and Marginal Cost for firms Exporting to China. Source: Authors' Calculations based on CMI Punjab 2000–2001, 2005–2006, 2010–2011 using the methodology developed by De Loecker et al. (2016). The prices are the product level prices observed directly in the CMI dataset.

Table 4. Impact of Pakistan-China FTA's Tariff changes on product-level markup, price and marginal cost in Pakistan's textile sector.

Panel A: Impact of Tariff changes on Product Markup, Prices and Marginal Cost			
	Markup	***Prices***	***Marginal Cost***
	(1)	(2)	(3)
τ_{jt}	0.0151***	0.0057*	−0.0094*
	(0.0018)	(0.0033)	(0.0037)
N	2011	2011	2011
Panel B: Impact of Tariff changes on Product Markup, Prices and Marginal Cost by Export Status			
Exporters to China* τ_{jt}	0.0882***	0.1658***	0.0776***
	(0.0060)	(0.0103)	(0.0126)
Exporters to Other Destinations* τ_{jt}	−0.0029	−0.0438***	−0.0409***
	(0.0029)	(0.0050)	(0.0062)
Non-Exporters* τ_{jt}	0.0145***	0.0121**	−0.0024
	(0.0023)	(0.0040)	(0.0049)
N	2011	2011	2011

The table presents the analysis of the impact of product level tariff changes on product level markups, prices and marginal cost. Panel A shows the results of the impact of tariffs on markups, prices and marginal cost directly while panel B disaggregates the effect according to the export status of the firm. Controls include pre-FTA firm productivity, pre-FTA quality, Pre FTA-number of products, and firm inputs, dummies for missing data by year, segment, year and segment-year fixed effects. In addition to this, we also control for firm-product fixed effects. Robust Standard Error in parentheses.

***, **, * significant at 1%, 5% and 10% levels of significance respectively.

remained unaffected on average, only increasing for differentiated goods (rather than homogeneous goods).

Yang (2020) examines the impact of China joining the World Trade Organization (WTO). With this, Chinese firms faced lower export barriers and started exporting products which had only been profitable in the domestic market. As a result, when these 'domestic only' goods entered the product mix of exported products, the markups of exporters rose, indicating that these domestic only goods were associated with higher markups. However, with time, Chinese firms noticed the potential to export products with lower markups. Over time, once they finished adjusting their product mix, the exported products reverted back to the long-term trend of being associated with lower markups. The possible explanation for this could be that Chinese firms exported products which were homogeneous in relation to the competitive (narrowly defined)

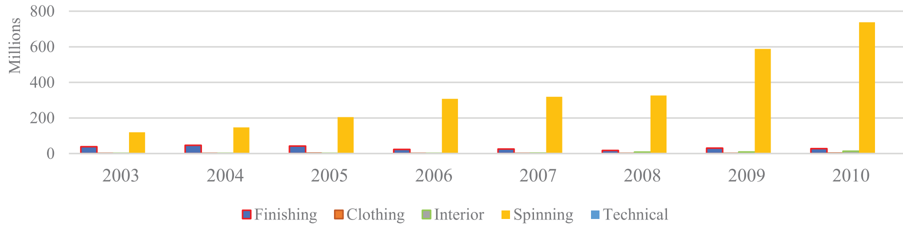


Figure 4. Pakistan's Exports to China ($US Millions) – Segment Wise.

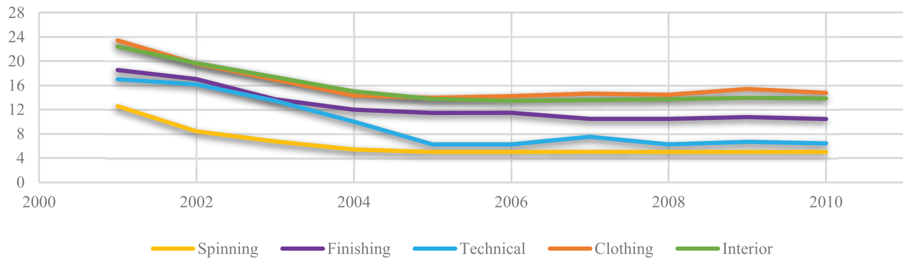


Figure 5. China's Segment Wise Tariff Rates for Pakistan.

industry. Since these products had lower markups, this automatically results in lower markups overall.

The situation of exported Pakistani products is similar to Lamorgese, Linarello, and Warzynski (2015) and Yang (2020). A possible reason for the fall in product level markups in our case could be that the main products Pakistan has been exporting to China have been relatively homogeneous. Figure 4 shows that the main exporting segment has been the spinning segment, which is relatively homogeneous as compared to other segments like technical garments or clothing that have greater scope for product differentiation. This is mainly because, under the FTA, Pakistan benefited from lower tariffs on products in the spinning segment as shown in Figure 5. In other words, since Pakistan has been offered lower tariffs on products which belong to a relatively homogeneous segment with lower margins to begin with, the FTA led to lower overall product-level markups.

Opening up to trade can move the marginal cost in either direction. Larger demand for the product might induce other firms to enter, or the firms might compete on inputs, driving the marginal cost up as a result of the new trade opportunities. Moreover, substantial quality improvements might also cause marginal costs to increase. We see this as the case for firms exporting to other destinations where the quality competition seems to be stronger due to larger market size (e.g. in the US or EU market).

For firms exporting to China, we see that marginal costs fell, indicating an overall increase in productivity similar to Lamorgese, Linarello, and Warzynski (2015). There are several channels through which a fall in marginal cost indicates productivity gains. Firms might self-select by reallocating resources either across firms or even across products within firms or by reducing X-inefficiencies and with the adoption of better management practices (Bloom et al. 2013; Bloom, Draca, and VanReenen 2016; Phan and Jeong 2016; Mayer, Melitz, and Ottaviano 2021). Mazorodze (2020) suggests that trade promotes input-oriented technical efficiency through cost-cutting practises that reduce inefficiency. Global trade competition encourages local industries to streamline their operations and abandon production practices that are incompatible with the cost-cutting goal, ultimately reducing costs. Another branch of literature suggests that marginal costs might fall as firms increase productivity by investing more in R&D and capital (Bustos 2011; Stoyanov 2013; Peters, Roberts, and Vuong 2022; Maican et al. 2020).

In a companion paper, we examined how this FTA impacted the productivity, quality, product mix, and investment decisions of Pakistani firms in the textile sector. We find evidence that firms exporting to China experienced an increase of 3–8 percent in productivity while quality rose only by 1–2 percent. Since the productivity gains outweigh the quality gains, falling marginal costs for firms exporting to China as a result of the FTA seems reasonable. Despite these productivity gains, we find evidence that firms increased their labor and material usage, but not capital (Jamil, Chaudhry, and Chaudhry 2022) as a result of the FTA. Wadho and Chaudhry (2018) find similar results where the innovation activities amongst Pakistani textile exporters remained largely concentrated within the exporters active in larger markets like the EU and US. Hence, while one branch of literature supports the idea that opening up to trade leads to more investments and R&D as the possible reason for the fall in marginal costs (Peters, Roberts, and Vuong 2022; Maican et al. 2020), we find no such evidence in our case. On the other hand, the textile firms do reduce their product offerings as a result of the FTA, indicating reallocation of resources within the firms as a possible explanation for the fall in marginal costs (Jamil, Chaudhry, and Chaudhry 2022).

Our findings are consistent with those in Kamal's (2021) study which investigated the pricing behaviour of Egyptian exporters based on product level analysis. The author found that higher export prices are associated with the sale of differentiated products. Furthermore, higher output prices are charged for products that are exported to more distant and wealthy markets. Carranza, González-Ramírez, and Perez (2020) further suggest that exports to wealthy countries are positively correlated with the quality of exported goods. Higher income per capita of the export markets is strongly correlated with consumer preference for high output quality. Higher quality output requires high quality inputs, which are expensive and are thus reflected in higher output prices. These analyses suggest that lower prices as a result of the FTA are inevitable in our context because Pakistan is not selling differentiated commodities to China. Additionally, under this FTA, Pakistan is focusing on exporting more to China, which is classified as an upper-middle income economy by the World Bank as opposed to a higher income economy (like the US and UK).[12] This limits the scope of increasing prices for Pakistani firms exporting to China.

While overall the product-level markups fall in our case as a result of a decline in product-level prices and marginal costs, we cannot yet say with confidence that pro-competitive effects exist (i.e. output tariff reductions put a downward pressure on markups). In order to confirm the existence of pro-competitive effects, one needs to control for the impact of output tariff concessions on marginal costs in order to isolate its effect. For example, if output tariffs reduce X-inefficiencies in firms, and they end up reallocating resources, they might ultimately adjust their markups as a result of cost changes. This simultaneous effect of output tariff reductions on marginal costs and markups makes it difficult to comment on the existence of pro-competitive effects.

Table 5. Pro-competitive impact of output tariff on product level markup.

	Markup	
	(1)	(2)
τ_{jt}	0.0124***	0.0031**
	(0.0016)	(0.0015)
Exporters to China* τ_{jt}		0.1067***
		(0.0054)
N	2011	2011
Second-order polynomial of marginal costs	Yes	Yes

Controls include pre-FTA firm productivity, pre-FTA quality, Pre FTA-number of products, and firm inputs, dummies for missing data by year, segment, year and segment-year fixed effects. In addition to this, we also control for firm-product fixed effects. Robust Standard Error in parentheses.
***, **, * significant at 1%, 5% and 10% levels of significance respectively.

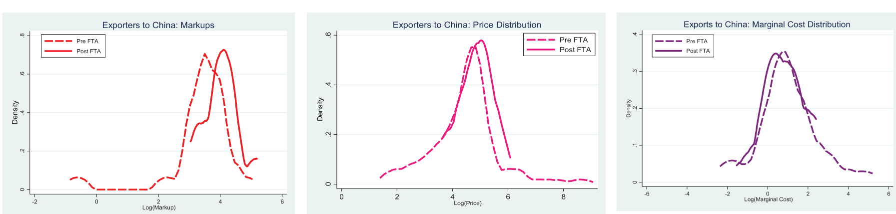
Hence, to identify the pro-competitive effects, one needs to control for simultaneous shocks to marginal costs (DeLoecker et al. 2016).

Following De Loecker et al. (2016), we examine the impact of changes in output tariffs on markups conditional on marginal costs. This is done to isolate the direct effect of pro-competitive trade on product-level markups after trade liberalization. The results are presented in Table 5. In column 1, we look at the impact of output tariffs on markups conditional on marginal costs. In column 2, we add in the interaction term *Exporters to China** τ_{jt} to identify the existence of pro-competitiveness for firms exporting specifically to China.

Our results indicate the presence of pro-competitive effects of trade liberalization on product-level markups. The coefficients in column (1) and (2) are significant and positive. Pakistani exporters to China whose products benefited from a 10-percentage point decline in tariffs experienced a 1.067 percent relative decline in markups.

5.2. Firm-level impact of the FTA on markups, marginal cost, and prices

We now examine the impact of the Pakistan–China FTA on firm-level measures. We use the methodology by DeLoecker and Warzynski (2012) designed to estimate markups and marginal cost at the firm level. We use the output elasticities based on the System GMM (Blundell and Bond 1998) and GNR (2020).



Markups Prices Marginal Costs

Figure 6. Distributions of Firm Level Markups, Prices and Marginal Cost for firms exporting to China. Source: Authors' Calculations based on CMI Punjab 2000–2001, 2005–2006, 2010–2011 using the methodology developed by De Loecker & Warzynski (2012). We present the distributions based on the output elasticities estimated using the System GMM (Blundell and Bond 1998). The distributions based on the output elasticities from the GNR (2020) are very similar. The prices are aggregated at the firm level using product revenue shares.

We estimate equation (19) and (20) again but now without the subscript *j*. We now have the equations as:

$$Y_{ft} = \alpha_t + \alpha_s + \alpha_{st} + \gamma\tau_{it}^{firm} + \theta\boldsymbol{C}_{ft} + \varepsilon_{ft} \tag{21}$$

$$Y_{ft} = \alpha_t + \alpha_s + \alpha_{st} + B((Export\ Status,\ Export\ Status * \tau_{it}^{firm}) : \beta, \delta) + \theta\boldsymbol{C}_{ft} + \varepsilon_{ft} \tag{22}$$

Figure 6a–c shows the distribution of firm-level markups, prices, and marginal costs both before (2000–2005) and after (2010) the Pakistan–China Free Trade Agreement went into effect for exporters to China. The distributions indicate that exporters to China marginally increased markups. The price seems to be less dispersed after the FTA went into effect, while there is little change in the marginal costs.

In Table 6, we present the results of the impact of the output tariff changes on the firm-level markups, prices, and marginal costs. In Panel A we test the impact of tariff reductions overall for each methodology and in Panel B by the export status of the firm.

Results from both the System GMM (Blundell and Bond 1998) and GNR (2020) estimations do not show any significant changes in firm-level markups for firms exporting to China as a result of the reductions in tariffs. These firms significantly lowered their prices along with a significant decline in their marginal costs; a 10 percentage point decline in tariffs is associated with a 1.770 percent decline in prices for firms exporting to China along with a 1.759 percent decline in the marginal costs (Panel B column 5). So, at the firm level, there was no significant changes in markups due to tariff reductions.

Our results are similar to the Garcia-Marin and Voigtländer (2019) who found little change in markups for firms in Mexico, Colombia, and Chile that gained market access. They found that firms, particularly the export entrants, do experience efficiency gains, but they are passed on to the customers by lowering prices. Due to constant markups and falling prices, these firms experienced relatively constant total factor revenue productivity (TFPR). Their results support the idea of a 'demand accumulation process' as suggested by Foster, Haltiwanger, and Syverson (2016) where firms lower their market price to attract more buyers. They show that exporters lowered their prices much more than the firms selling domestically (19% versus 8%). Even in our case, while firms change their prices, firms selling domestically (i.e. non-exporters) have the least change in prices (1.147 percent decline in prices for a 10 percentage point decline in tariffs).

Hornok and Murakozy (2019) examine the impact of trade liberalization on firms in Hungary from 1995 to 2003. They find no evidence for an exporter markup premium. This may be due to strong competition faced in the international market or due to dynamic pricing as suggested by Garcia-Marin and Voigtländer (2019).

Xiang et al. (2017), on the other hand, find that firm markup falls as output tariffs decrease. Following the methodology by De Loecker and Warzynski (2012), they compute firm-level markups for the firms in China for the period 2000–2006. They show that an output tariff decline of 9.5% is associated with a markup decline of 0.1%. Their results suggest that the effects of trade liberalization on firm markups depend upon the industry concentration. They compute the Herfindahl–Hirschman index (HHI) and show that the pro-competitive effects of output tariff reduction are only found in industries with a higher HHI. This may be because output tariffs reduce marginal cost by reducing X-inefficiencies as suggested by De Loecker et al. (2016). Industries which are more concentrated have more room for improvement in X-inefficiencies and hence, the pro-competitive effect of output tariff reduction is more.

Table 6. Impact of Pakistan-China FTA's tariff changes on firm markup, marginal costs and prices in Pakistan's textile sector.

Panel A: Impact of Tariff changes on Firm Markups, Price and Marginal Cost					
	Markups		***Price***	***Marginal Costs***	
	System GMM Methodology	*GNR (2020) Methodology*	-	*System GMM Methodology*	*GNR (2020) Methodology*
	(1)	(2)	(3)	(4)	(5)
τ_{it}^{firm}	0.0019	0.0047	0.1232***	0.1212***	0.1185***
	(0.0170)	(0.0137)	(0.0298)	(0.0318)	(0.0311)
N	1177	1177	1177	1177	1177
Panel B: Impact of Tariff changes on Firm Markup, Price and Marginal Cost by Export Status					
Exporters to China* τ_{it}^{firm}	−0.0082	0.0011	0.1770***	0.1852**	0.1759**
	(0.0543)	(0.0435)	(0.0634)	(0.0784)	(0.0743)
Exporters to Other Destinations* τ_{it}^{firm}	0.0271	0.0192	0.1238***	0.0967*	0.1046*
	(0.0276)	(0.0231)	(0.0408)	(0.0476)	(0.0460)
Non-Exporters* τ_{it}^{firm}	−0.0035	0.0018	0.1147***	0.1182***	0.1129***
	(0.0180)	(0.0142)	(0.0308)	(0.0330)	(0.0321)
N	1177	1177	1177	1177	1177

Authors' calculations based on OLS regression analysis of the impact of tariffs on firm-level markups, marginal costs and prices. Panel A shows the results of the net impact of tariffs on markups, marginal cost and prices directly while panel B disaggregates the effect according to the export status of the firm. We aggregate the product-level prices based on revenue shares. Controls include pre-FTA firm productivity, pre-FTA quality, pre-FTA number of products, and firm inputs, dummies for missing data by year, segment, year and segment-year fixed effects. Robust standard errors in parentheses.

***, **, * significant at 1%, 5% and 10% levels of significance respectively.

Table 7. Pro-competitive impact of output tariff on frim markup.

	Markups			
	System GMM Methodology		*GNR (2020) Methodology*	
τ_{it}^{firm}	0.0445**	0.0415**	0.0382**	0.0360**
	(0.0165)	(0.0166)	(0.0128)	(0.0129)
Exporters to China* τ_{it}^{firm}		0.0521**		0.0379**
		(0.0191)		(0.0168)
N	1177	1177	1177	1177
Second-order polynomial of marginal costs	Yes	Yes	Yes	Yes

Controls include pre-FTA firm productivity, pre-FTA quality, pre-FTA number of products, and firm inputs, dummies for missing data by year, segment, year and segment-year fixed effects. Robust standard errors in parentheses.
***, **, * significant at 1%, 5% and 10% levels of significance respectively.

In our case, concluding anything about the pro-competitive effects from Table 6 may be problematic. As suggested by De Loecker et al. (2016), markups might change due to changes in marginal costs. Thus, it is important to isolate the direct effect of pro-competitiveness as a result of trade liberalization on markups. We examine the impact of changes in output tariffs on markups conditional on marginal costs at the firm level.

The results are presented in Table 7. In column 1, we look at the impact of output tariffs on firm level markups conditional on marginal costs. In column 2, we add in the interaction term *Exporters to China** τ_{it}^{firm} to identify the existence of pro-competitiveness for firms exporting specifically to China.

Our results from Table 7 indicate the presence of pro-competitive effects at the firm level. Conditional on any potentially different impact of trade liberalization on the marginal costs, exporters to China who experience a 10-percentage point larger decline in tariffs experience a 0.521 percent (as in System GMM approach) relative decline in markups (0.379 percent in the case of GNR (2020) approach).

Our results suggest strong evidence of foreign competition faced by firms in international markets. As shown earlier in Table 1A–E, even after a decade of the Pakistan–China FTA, Pakistan (with the exception of the spinning segment) is still not amongst the top importing choices for China within the textile sector. As discussed above, spinning is a homogeneous segment as compared to other segments like interior and clothing. Products in this segment are low-markup products to start with. Epifani and Gancia (2011) suggest that markups can be improved and that trade policy and domestic industrial policy are complementary in the case of heterogeneous markups. Pakistan's concentration on the spinning segment limits that heterogeneity.

Antoniades (2015) finds evidence that in industries where there is a greater scope of quality differentiation due to a high level of heterogeneity, highly productive firms improve quality as a result of trade liberalization. Even if marginal costs fall for such firms, increases in markups offset the falling costs and firm prices increase as productivity rises. However, when the firm is active in a more homogeneous segment, with limited scope of quality differentiation, an increase in markups is not sufficient to offset the falling costs and markups do not rise as fast as productivity rises. Hence, the price falls as productivity increases. Hosein, Satnarine-Singh, and Saridakis (2023) further suggest that even the projected impact of external shocks (economic and natural shocks) on small resource-dependent economies is higher due to low export diversification.

Moreover, Figure 5 also shows that given the fact that the ASEAN nations face lower Chinese tariffs than Pakistani textile firms, firms in Pakistan engage in dynamic pricing in order to compete with other countries to capture the a larger share of the Chinese market despite greater access under the FTA. Gust, Leduc, and Vigfusson (2010) develop a model to suggest that the environment in which the exporters set their prices depends upon strategic complementary. With more trade integration, the exporting firms become more responsive to the prices set by their competitors, which seems to be the case for Pakistani firms.

6. Conclusion

With the growing importance of international trade, there has been an increase in the number of countries entering into free trade agreements to enhance bilateral trade flows. While a substantial amount of literature focuses on the impact of better availability of intermediate inputs through trade on firm-level outcomes, the literature on the impact of FTAs on firms is more limited. We study how firms in the textile sector in Pakistan responded by changing markups, prices, and marginal costs as a result of increased trade liberalization. We also study the relationship between trade policy and welfare outcomes by examining the existence of pro-competitiveness at both the product and firm level.

We use the methodology developed by DeLoecker et al. (2016) to estimate product level markups and marginal cost. We also analyze firm-level markups and marginal cost with the methodology developed by De Loecker and Warzynski (2012). The output elasticities are computed based on the extended or System GMM estimator (Blundell and Bond 1988) and Gandhi, Navarro, and Rivers (2020) methodology.

Our results suggest that the firms exporting to China did significantly lower their prices, engaging in dynamic pricing as a way to compete with other firms within the Chinese market. Pakistani firms exporting to China were at a disadvantage when China eliminated most tariffs on textile products coming from ASEAN countries. This advantage for the ASEAN countries has had long lasting effects since Pakistan is still not one of the largest exporters of textiles to China a decade after the signing of the FTA.

Moreover, marginal costs did decline as a result of the FTA, indicating reductions in X-inefficiencies as a result of trade liberalization. Markups at the firm level, however, remain unchanged. We also find evidence of the existence of pro-competitive effects due to the reduction in output tariffs on markups.

Our results imply that one of the reasons why firm-level markups remain unchanged (or decrease in the product level analysis) is that most of Pakistan's exports to China have been in the spinning segment. The spinning segment is more homogeneous than other segments having greater quality variation and varieties of differentiated products. Homogeneous segments like the spinning segment start out as low-markup segments, which means (as pointed out in the literature) that changes in trade policies are not accompanied by variations in markups. This restricts the scope of quality differentiation and markup margins for Pakistani exporters. This points towards the need for policymakers in Pakistan to focus more on heterogeneous segments of the textile sector (like clothing or interior), which are relatively demand-elastic and have the potential for higher markups.

Notes

1. The products are classified into five segments as done by De Leocker (2011).

2. Input allocation across multiple products produced by a firm is hardly observed in any micro data set. Hence, many studies have made assumptions regarding this allocation based on the number of products (De Loecker 2011) and revenue shares (Foster et al. 2008).
3. Using this input-output relationship, a single product firm manufacturing motorcycles will use the same technology as a multiproduct firm manufacturing motorcycles and cars.
4. This expression can encompass both a value-added function and a gross output function. In the former case, only labor and capital enter the input set while in the former the input set in addition to labor and capital is a function other intermediate inputs e.g., materials.
5. This is the marginal cost since $\frac{\partial \mathcal{L}_{it}}{\partial Q_{it}} = \lambda_{it}$
6. This expression for markup as a ratio of price over marginal cost is robust in various price (static) setting models and does not depend on a particular form of price competition amongst firms. However, it will depend on the specific nature of competition amongst firms. One restriction imposed is that prices are set period by period ruling out any cost adjustments of changing prices. Markups, however, will depend on the interaction amongst firms and the strategic interaction between them. We direct the reader towards the online appendix of De Leocker & Warzynski (2012) for discussion on some leading cases in this.
7. If one is further interested to back out the capital and labor coefficients based on the GNR (2020), the next step is to rely on partial differential equations for the production function and integrate them based on moment conditions on innovation in productivity which follows the Markov process. This last step then helps recover the capital and labor coefficients.
8. This means that our data set allows us observe the changes in the product mix for each firm at different points in time.
9. 1 PKR equals to approximately $ 0.0044 as in 2022. The values reported in the table are current PKR.
10. Based on De Loecker's (2011) classification, we divide the textile sector into five segments: (i) finishing (ii) spinning, (iii) interior, (iv) clothing, and (v) technical.
11. We multiply the coefficients by the average change in tariffs, which was 61.8% in our case to get the net impact. For example, the net impact of the FTA on the markups for firms exporting to China is 0.0882*0.618.
12. World Bank country classification is available at: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

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ORCID

Nida Jamil http://orcid.org/0000-0002-4113-5337
Theresa Chaudhry http://orcid.org/0000-0002-3248-8018
Azam Chaudhry http://orcid.org/0000-0003-0401-7099

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